

WHAT IS CLAIMED IS:

1. A packet processing system comprising:
 - a forwarding device that transmits and receives a packet through a network interface; and
 - 5 a control device that transfers the packet between the control device and the forwarding device, and responds to the packet using an application, wherein
 - the control device includes
 - a symbol section that is associated with address
 - 10 information of the forwarding device; and
 - a first transfer control section that when detecting that the application accesses the symbol section, sets a packet transfer rule in the forwarding device by transmitting to the forwarding device a setting request that the forwarding device sets the packet transfer rule
 - 15 that is used to transfer the received packet to the control device, and
 - the forwarding device includes
 - a second transfer control section that sets the packet transfer rule in response to the setting request.
- 20 2. The packet processing system according to claim 1, wherein
 - the first transfer control section, when detecting that the application closes a communication port for access to the symbol section, cancels the packet transfer rule in the forwarding device by transmitting to the forwarding device a cancel request that the
 - 25 forwarding device cancels the packet transfer rule, and

the second transfer control unit cancels the packet transfer rule in response to the cancel request.

3. The packet processing system according to claim 1, wherein the
5 symbol section is a virtual interface corresponding to the network interface.

4. The packet processing system according to claim 3, wherein the forwarding device further includes an interface determination section
10 that when receiving from the control device an interface request that the forwarding device provides the network interface to the control device, determines whether the network interface is available.

5. The packet processing system according to claim 1, wherein the
15 packet transfer rule indicates to encapsulate the packet so as to include a tunnel identifier and to transfer the packet between the control device and the forwarding device.

6. The packet processing system according to claim 5, wherein
20 the tunnel identifier includes
an up-tunnel identifier that is associated with the network interface, a virtual interface corresponding to the network interface, an address of the control device, and a protocol address of the application;
and

25 a down tunnel identifier that is associated with a

transmission virtual interface for transmitting the packet, an address of the forwarding device, and a network interface corresponding to the transmission virtual interface.

5 7. The packet processing system according to claim 1, wherein the symbol section is a virtual IP address corresponding to an IP address of the forwarding device.

8. The packet processing system according to claim 1, wherein the
10 packet transfer rule indicates to convert an address of the packet and to transfer the packet between the control device and the forwarding device.

9. The packet processing system according to claim 1, wherein
15 the packet transfer rule defines up address conversion and down address conversion,

the up address conversion designates that a destination address of the packet is converted in the forwarding device from a virtual IP address to an address of the control device in the forwarding device,
20 the packet is transferred to the control device, and the destination address of the transmitted packet transmitted is converted from the address of the control device to the virtual IP address in the control device, and

the down address conversion designates that a sender address
25 of the packet is converted from a virtual IP address to an address of the

control device in the control device, the packet is transferred to the forwarding device, and the sender address of the transmitted packet is converted from the address of the control device to the virtual IP address.

5

10. The packet processing system according to claim 1, wherein the application is a path control process of a router.

11. The packet processing system according to claim 1, wherein the
10 control device and the forwarding device are connected to each other through a data link layer, and exchange data therebetween using a protocol for the data link layer.

12. A method of processing a packet between a forwarding device
15 and a control device, the forwarding device transmitting and receiving the packet through a network interface, the control device responding to the packet using an application, the method comprising:

associating a symbol section with address information of the forwarding device;

20 transmitting from the control device to the forwarding device a setting request that the forwarding device sets a packet transfer rule that is used to transfer the packet received to the control device, when the control device detects that the application accesses the symbol section;

25 setting the packet transfer rule in the control device; and

setting the packet transfer rule in response to the setting request in the forwarding device.

13. The method according to claim 12, further comprising:

5 transmitting from the control device to the forwarding device a cancel request that the forwarding device cancels the packet transfer rule, when the control device detects that the application closes a communication port for access to the symbol section;

canceling the packet transfer rule in the control device; and

10 canceling the packet transfer rule in response to the cancel request in the forwarding device.

14. The method according to claim 12, wherein the symbol section is a virtual interface corresponding to the network interface.

15

15. The method according to claim 12, wherein the packet transfer rule defines to encapsulate the packet so as to include a tunnel identifier and to transfer the packet between the control device and the forwarding device.

20

16. The method according to claim 12, wherein the symbol section is a virtual IP address corresponding to an IP address of the forwarding device.

17. The method according to claim 12, wherein the packet transfer rule defines to convert the address of the packet and to transfer the packet between the control device and the forwarding device.

- 5 18. A computer program product for processing a packet between a forwarding device and a control device, the forwarding device transmitting and receiving the packet through a network interface, a control device responding to the packet using an application, the computer program product including computer executable instructions
- 10 stored on a computer readable medium, wherein the instructions, when executed by the computer, cause the computer to perform:
- associating a symbol section with address information of the forwarding device;
 - transmitting from the control device to the forwarding device a

15 setting request that the forwarding device sets a packet transfer rule that is used to transfer the packet received to the control device, when the control device detects that the application accesses the symbol section;

 - setting the packet transfer rule in the control device; and

20 setting the packet transfer rule in response to the setting request in the forwarding device.

19. The computer program product according to the claim 18,
wherein the instructions further cause the computer to perform:

transmitting from the control device to the forwarding device a
cancel request that the forwarding device cancels the packet transfer
5 rule, when the control device detects that the application closes a
communication port for access to the symbol section;

canceling the packet transfer rule in the control device; and

canceling the packet transfer rule in response to the cancel
request in the forwarding device.

10

20. The computer program product according to the claim 18,
wherein the symbol section is a virtual interface corresponding to the
network interface.

15 21. The computer program product according to the claim 18,
wherein the packet transfer rule defines to encapsulate the pack so as
to include a tunnel identifier and to transfer the packet between the
control device and the forwarding device.

20 22. The computer program product according to the claim 18,
wherein the symbol section is a virtual IP address corresponding to an
IP address of the forwarding device.

23. The computer program product according to the claim 18,
wherein the packet transfer rule defines to convert the address of the
packet and to transfer the packet between the control device and the
forwarding device.

5

24. A packet processing system which performs communication with
a network node through a network interface of a forwarding device,
wherein

the network interface of the forwarding device and an
10 application on a control device are connected to each other by an
internal communication path,

the control device includes

a symbol setting unit that sets a symbol section that
communicates with the application on the control device and associates
15 it with an interface of the forwarding device;

a first downstream path generation unit that receives
from the forwarding device a downstream internal communication path
identifier of a downstream internal communication path on which data is
transferred in a direction from the symbol section to the interface of the
20 forwarding device, and that generates a first downstream path table
where the downstream internal path identifier is associated with the
symbol section and an address of the forwarding device;

a first upstream path generation unit that receives a start
message that the application starts communicating with the symbol
25 section, that transmits an input-output port identifier of the process and

an upstream internal communication path identifier to the forwarding device, and that generates a first upstream path table where the upstream internal path identifier is associated with the symbol section and the input-output port identifier, and

5 the forwarding device includes

 a second downstream path generation unit that generates a second downstream path table where the downstream internal path identifier is associated with the interface of the forwarding device; and

10 a second upstream path generation unit that generates a second upstream path table where the input-output port identifier of the process, the upstream internal communication path identifier, and the interface are associated with each other.

15 25. The packet processing system according to claim 24, wherein the control device further includes

 a first path delete unit that when the application is completed, transmits to the forwarding device a delete request to delete elements of the second upstream path table, and that deletes the
20 elements of the first upstream path table, which corresponds to the completed application, and

 the forwarding device further includes

 a second path delete unit that deletes the elements of the second upstream path table in response to the delete request.

25

26. The packet processing system according to claim 24, wherein the forwarding device further includes an interface manage section that when receiving from the control device an interface request to provide the interface to the control device, determines whether the interface is
5 available.

27. The packet processing system according to claim 24, wherein the control device further includes
a first path transfer unit that encapsulates a data packet
10 received from the symbol section based on the first downstream path table, that transmits the encapsulated data packet to the forwarding device, when receiving the encapsulated data packet from the upstream path, that decapsulates the packet based on the first upstream path table, and that transfers the data packet to the symbol section, and
15 the forwarding device further includes
a second path transfer unit that encapsulates a data packet received from the interface based on the second upstream path table, that transmits the encapsulated data packet to the control device, that decapsulates the data packet received from the control device
20 based on the second downstream path table, and that transfers the data packet decapsulated to the interface.

28. The packet processing system according to claim 24, wherein the symbol section is a virtual interface which corresponds to an
25 interface of the forwarding device.

29. The packet processing system according to claim 28, wherein the application of the control device is a path control process of a router.

5 30. The packet processing system according to claim 24, wherein the control device and the forwarding device are connected to each other through a data link layer, and exchange data therebetween using a data link layer protocol for exchanging the control message between the control device and the forwarding device.

10

31. A method of processing a packet in communication with a network node through a network interface of a forwarding device, wherein the network interface of the forwarding device and an application on a control device are connected to each other by an

15 internal communication path, the method comprising:

setting a symbol section that communicates with the application on the control device and associates it with an interface of the forwarding device;

20 receiving from the forwarding device a downstream internal communication path identifier of a downstream internal communication path on which data is transferred in a direction from the symbol section to the interface of the forwarding device, in the control device;

generating a first downstream path table where the downstream internal path identifier is associated with the symbol section and an
25 address of the forwarding device;

receiving a start message that the application starts
communicating with the symbol section, in the control device;

transmitting from the control device to the forwarding device an
input-output port identifier of the application and an upstream internal
5 communication path identifier;

generating a first upstream path table where the upstream
internal path identifier is associated with the symbol section and the
input-output port identifier;

generating a second downstream path table where the
10 downstream internal path identifier is associated with the interface of
the forwarding device; and

generating a second upstream path table where the input-output
port identifier of the application, the upstream internal communication
path identifier, and the interface are associated with each other.

15

32. The method according to claim 31, further comprising:

receiving a complete message that the application is completed,
in the control device;

transmitting from the control device to the forwarding device a
20 delete request to delete elements of the second upstream path table,
which corresponds to the completed application;

deleting the elements of the first upstream path table;

deleting the elements of the second upstream path table in
response to the delete request.

25

33. The method according to claim 31, further comprising determining whether the interface is available when receiving from the control device an interface request to provide the interface to the control device.

5

34. The method according to claim 31, further comprising:
encapsulating a data packet received from the symbol section based on the first downstream path table;
transmitting from the control device to the forwarding device the
10 encapsulated data packet;
decapsulating the packet based on the first upstream path table when receiving the capsulated data packet from the upstream path;
transferring the decapsulated data packet to the symbol section;
encapsulating a data packet received from the interface on the
15 forwarding device based on the second upstream path table;
transmitting from the forwarding device to the control device the data packet encapsulated;
decapsulating the data packet received from the control device based on the second downstream path table; and
20 transferring the decapsulated data packet to the interface.

35. The method according to claim 31, wherein the symbol section is a virtual interface which corresponds to an interface of the forwarding device.

25

36. The method according to claim 35, wherein the application of the control device is a path control process of a router.

37. The method according to claim 31, wherein the control device and the forwarding device are connected to each other through a data link layer, and exchange data therebetween using a data link layer protocol for exchanging the control message between the control device and the forwarding device.

38. A computer program product for processing a packet in communication with a network node through a network interface of a forwarding device, wherein the network interface of the forwarding device and an application on a control device are connected to each other by an internal communication path, the computer program product including computer executable instructions stored on a computer readable medium, wherein the instructions, when executed by the computer, cause the computer to perform:

setting a symbol section that communicates with the application on the control device and associates it with an interface of the

forwarding device;

receiving from the forwarding device a downstream internal communication path identifier of a downstream internal communication path on which data is transferred in a direction from the symbol section to the interface of the forwarding device, in the control device;

generating a first downstream path table where the downstream

internal path identifier is associated with the symbol section and an address of the forwarding device;

receiving a start message that the application starts communicating with the symbol section, in the control device;

5 transmitting from the control device to the forwarding device an input-output port identifier of the application and an upstream internal communication path identifier;

generating a first upstream path table where the upstream internal path identifier is associated with the symbol section and the
10 input-output port identifier;

generating a second downstream path table where the downstream internal path identifier is associated with the interface of the forwarding device; and

generating a second upstream path table where the input-output
15 port identifier of the application, the upstream internal communication path identifier, and the interface are associated with each other.

39. The computer program product according to the claim 38, wherein the instructions further cause the computer to perform:

20 receiving a complete message that the application is completed, in the control device;

transmitting from the control device to the forwarding device a delete request to delete elements of the second upstream path table, which corresponds to the completed application;

25 deleting the elements of the first upstream path table;

deleting the elements of the second upstream path table in response to the delete request.

40. The computer program product according to the claim 38,
5 wherein the instructions further cause the computer to perform determining whether the interface is available when receiving from the control device an interface request to provide the interface to the control device.

10 41. The computer program product according to the claim 38, wherein the instructions further cause the computer to perform:
encapsulating a data packet received from the symbol section based on the first downstream path table;
transmitting from the control device to the forwarding device the
15 encapsulated data packet;
decapsulating the packet based on the first upstream path table when receiving the capsulated data packet from the upstream path;
transferring the decapsulated data packet to the symbol section;
encapsulating a data packet received from the interface on the
20 forwarding device based on the second upstream path table;
transmitting from the forwarding device to the control device the encapsulated data packet;
decapsulating the data packet received from the control device based on the second downstream path table; and
25 transferring the decapsulated data packer to the interface.

42. The computer program product according to claim 38, wherein the symbol section is a virtual interface which corresponds to an interface of the forwarding device.

5 43. The computer program product to claim 42, wherein the application of the control device is a path control process of a router.

44. The computer program product according to claim 38, wherein the control device and the forwarding device are connected to each
10 other through a data link layer, and exchange data therebetween using a data link layer protocol for exchanging the control message between the control device and the forwarding device.